

14 MANAGEMENT OF THE SERIOUSLY INJURED CASUALTY

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Trauma is a leading cause of death and serious injury on expeditions. Major trauma is predominantly caused by road traffic accidents and falls. It is important to remember the limitations of medical care in a remote environment. One of the main factors that aids survival in victims of serious trauma is early access to definitive care, i.e. surgery and intensive care facilities. Once basic resuscitation and management of the casualty's airway, breathing and circulation are under way, rapid evacuation is essential. This chapter is largely intended for medically trained professionals.

THE APPROACH TO THE SERIOUSLY INJURED CASUALTY

When approaching a seriously injured casualty follow the principles of first aid as outlined in Chapter 13 (page 130, Table 13.1). Firstly, check that the incident scene is safe. This is especially important in the case of road traffic accidents, rock falls and avalanches. An injury sustained by a rescuer simply compounds the situation.

The casualty should be approached using the "ABC" principle. This is known as the *primary survey*. The airway should be assessed and maintained with cervical spine immobilisation. Following this, the casualty's breathing and circulation should be assessed. Managing the casualty in this sequence ensures that the most life-threatening problems are addressed first. For example, casualties will die from an obstructed airway before they would from a collapsed lung. This ABC approach also ensures that the ultimate aim of resuscitation is achieved, i.e. the supply of oxygenated blood to the vital organs.

Primary survey

Airway

The airway can be obstructed in the trauma casualty for a number of reasons. These include facial fractures, swelling, blood and foreign bodies such as dislodged teeth. If

the patient is unconscious, lack of muscle tone will cause the tongue to fall against the back of the throat, blocking the airway.

Assessment of the airway is relatively simple. If the patient is talking normally, the airway can be assumed to be normal. If the patient is not talking, ask them to stick their tongue out. Again, if they can do this, the airway will usually be clear. If they can't do this, the signs of airway obstruction should be looked for.

TABLE 14.1 SIGNS OF AIRWAY OBSTRUCTION

- Distress
- Cyanosis (blueness)
- Noisy breathing – gurgling
- Stridor – a rasping sound on inspiration

If the airway is obstructed, a jaw-thrust manoeuvre should be carried out. This pushes the jaw forwards and hence pushes the tongue away from the back of the throat. The jaw-thrust manoeuvre is carried out by placing both thumbs on the patient's cheekbones and the index fingers behind the angles of the jaw. The index fingers are then pushed forwards. The chin-lift technique is not appropriate for trauma situations as it involves moving the neck, which may cause a spinal cord injury.

Foreign bodies that can be clearly seen in the mouth should be removed. Blind finger sweeps should be avoided, as they tend to push the foreign body further down.

If the casualty carer has been trained to use oropharyngeal or nasopharyngeal airways, these may be used to aid airway maintenance. Remember that, although these devices may open the airway, they do not protect it from regurgitated stomach contents. Regurgitated stomach contents, if inhaled, can cause serious lung damage. If stomach contents are being regurgitated or if there is bleeding in the mouth, the patient should be rolled on to their side. This should be carried out with maintenance of in-line spinal immobilisation.

There is probably little role for endotracheal intubation for seriously injured casualties in the remote expedition environment. Casualties who can be intubated without the use of anaesthetic drugs have a very poor prognosis. Furthermore, blind insertion of devices such as laryngeal mask airways or Combitubes in the semiconscious casualty may cause laryngospasm, vomiting and raised intracranial pressure.

Most airways can be maintained by a simple jaw thrust and a basic airway adjunct. Basic airway management is the most important skill for the casualty carer at all levels

Spinal immobilisation

Spinal injuries can occur in the neck, chest or lumbar area. Injuries to the thoracic and lumbar spine usually result from high-energy trauma such as high falls and road traffic accidents. Injuries to the neck (cervical spine), however, may occur following relatively minor trauma.

Assume that every trauma casualty has a spinal injury!

The danger associated with a spinal injury is damage to the spinal cord, which will cause paraplegia or tetraplegia. It should be understood that injured casualties may have spinal fractures with no damage to their spinal cord following the accident. However, inappropriate handling or movement by the casualty or casualty carer may cause damage to the cord at this stage. The aim of spinal immobilisation and appropriate casualty handling is to prevent spinal cord damage in casualties with spinal injuries.

There are many signs of spinal fractures and spinal cord damage. The presence of any of these signs indicates the presence of injury. Their absence, however, does not exclude a spinal injury, i.e. they can “rule in” but can’t “rule out” injury. Spinal injuries can only be absolutely excluded in hospital following assessment and radiological imaging.

Signs of spinal fractures or dislocations may be indicated by tenderness, swelling, bruising or steps (abnormal knobs or depressions) felt when pressing on the spine. Spinal cord injury may be indicated by numbness, tingling or weakness in the limbs.

Cervical spine immobilisation should be initiated at the same time as the airway is assessed and managed. *The casualty carer should position themselves at the head of the casualty and place their hands on either side of the head to prevent head and neck movement.* This role can be taken by other members of the group when they arrive, to free up the main casualty carer for other tasks.

TABLE 14.2 TO STABILISE NECK INJURIES
<ul style="list-style-type: none"> • Reassure the casualty and tell them not to move • Steady and support the head in the neutral position, placing your hands on the side of the head. Maintain this support • Add a hard neck collar if available (to immobilise the neck) but always continue to hold the head and neck

If the head is lying to one side, it should be gently moved to its neutral position with the neck in line with the rest of the spine. Returning the neck to this position is extremely unlikely to cause any spinal cord injury.

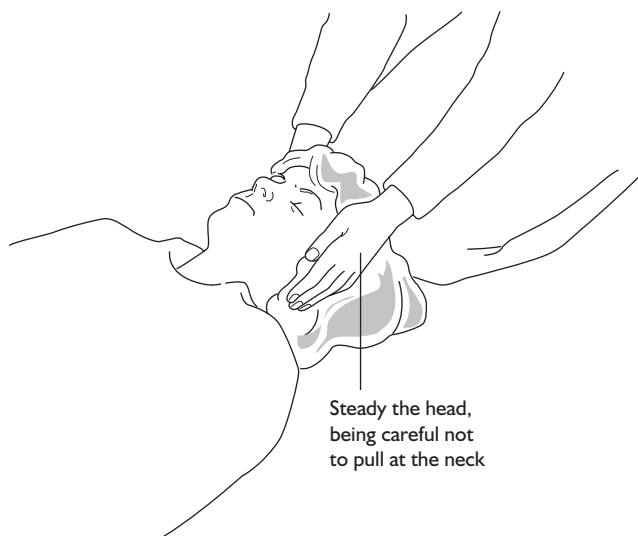


Figure 14.1 *Stabilisation of the neck*

If a cervical collar is available, this should be applied. Recently, a number of collars that are adjustable in size have become commercially available. These are ideal for remote travel as the number of collars that need to be carried is reduced from four to one. Appropriate training in their sizing and application should be undertaken before the expedition. The head should continue to be held even after application of the collar; 40% of the normal range of movement of the neck is still possible with a correctly sized collar in place.

The casualty should be log-rolled (see below) and placed onto a flat surface such as a rigid stretcher for evacuation. Placing casualties on hard surfaces such as rigid stretchers or spinal boards is uncomfortable and may rapidly cause serious pressure sores (these may occur within one hour). The stretcher should therefore be padded with a sleeping mat or Thermarest. Prolonged evacuations will require the patient to be turned frequently in order to prevent pressure sores developing.

TABLE 14.3 TO TURN/ROLL A PATIENT WITH A SUSPECTED SPINAL INJURY
<ul style="list-style-type: none"> • Stabilise the neck as in Figure 14.1 • While maintaining support at the neck, ask (ideally) four people to help log-roll the patient, keeping the head, trunk and legs in a straight line

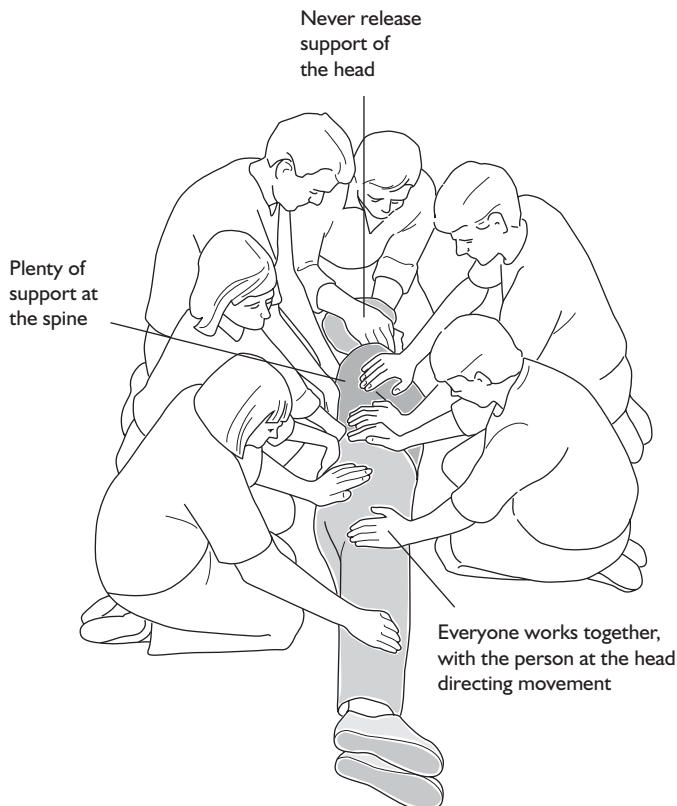


Figure 14.2 The “log-roll” method to turn or roll a casualty with a suspected spinal injury

The casualty’s head should be taped to the sides of the stretcher and rolled-up clothing placed on either side of the head to increase stabilisation. Only following this can the casualty carer stop holding the patient’s head.

The most effective device for immobilising seriously injured casualties is the vacuum mattress. This is a hollow mattress, 5cm deep and filled with beads, which is moulded to the patient. The air is then removed from the mattress to form a rigid surface. This is more comfortable for prolonged transfers and reduces the incidence of pressure sores. This piece of kit is carried by almost all mountain rescue teams in the United Kingdom but is relatively expensive and bulky.

Spinal cord injuries in the neck may cause a condition known as neurogenic shock. Loss of nerve supply to blood vessels causes them to dilate, increasing their volume and hence reducing the blood pressure. In some cases, loss of nerve supply to the heart may cause a loss of the heart’s drive to increase its rate to compensate for

this low blood pressure. These patients, unlike those suffering shock from blood loss, may have a low blood pressure and a low or normal pulse rate.

Breathing

The respiratory status is assessed by examining the casualty's general appearance and respiratory rate, and listening to the chest.

Serious chest injuries may be indicated by:

- Distress
- Use of accessory breathing muscles in the arms and neck
- Increased respiratory rate
- Increased heart rate
- Cyanosis.

There are many types of injuries to the chest and chest wall which may cause compromised respiratory function.

1 **Fractured ribs** usually cause no serious problems. Movement of the fractured ribs with inspiration and movement causes sharp pain with local tenderness. This pain will be present until the fracture heals, which may take up to 6 weeks. Casualties will require good pain relief with ibuprofen or stronger painkillers (see Chapter 13, pages 155–7). The three potential complications of rib fractures are chest infection, pneumothorax (if the fractured rib ends puncture the lining of the lung) and flail chest.

2 A **flail segment** results when a number of adjacent ribs are each fractured at two separate places along their length. This results in an area of chest wall that is not fixed to the rest of the chest wall. This section of chest wall moves independently from the rest of the chest wall, moving inwards on inspiration instead of outwards. A large force is involved in these injuries and in all cases the lung underneath is damaged, causing a pulmonary contusion. These injuries are often also associated with a pneumothorax.

The pain associated with these injuries and the underlying pulmonary contusion often cause marked respiratory failure. Patients will show signs of respiratory distress and the paradoxical movement of the flail segment is often obvious.

Casualties should be given oxygen if available. They will require strong analgesia. Pain can also be reduced by splinting the flail segment to prevent its independent movement. This can be improvised by taping a rolled-up bandage or pair of socks over the flail segment. This is a very serious injury and casualties will require evacuation.

3 A **simple pneumothorax** or collapsed lung results from air collecting between the chest wall and the outer lining of the lung following puncture or rupture of the lung.

This can result from wounds penetrating the chest wall or fractured ribs damaging the lining of the lung. As most people can function adequately with only one lung, signs of respiratory distress are often minimal.

A simple pneumothorax is diagnosed clinically by listening to and percussing the chest. The side of the chest with the pneumothorax will have decreased air entry (reduced breath sounds) and will be more resonant to percussion than the normal side.

Patients with a simple pneumothorax should be given oxygen if available. All patients with a traumatic pneumothorax require the insertion of a chest drain and evacuation. The insertion of a Venflon into the chest is not indicated in a simple pneumothorax, even if traumatic in origin. The patient should be reassessed regularly for the development of a tension pneumothorax and this should be treated if it arises. Extreme care should be taken when considering evacuation of casualties with pneumothoraces by air (see Chapter 16).

4 A **tension pneumothorax** is an immediately life-threatening injury. It occurs in the same way as a simple pneumothorax. The complicating factor is that the source of the air filling the space between the chest wall and the lung, i.e. the hole in the chest wall or lung, acts as a one-way valve. This allows air into the cavity with inspiration but closes off with expiration, preventing air from escaping. As a result, the volume and pressure in the chest constantly increase. The volume increases so much that the heart and opposite lung are pushed over to the opposite side of the chest. This stops the other lung from functioning and stops blood flow to the heart.

The features of a tension pneumothorax include:

- Decreased air entry on side of pneumothorax
- Hyper-resonance to percussion on side of pneumothorax
- Trachea deviated away from side of pneumothorax
- Distended neck veins
- Marked signs of respiratory distress (cyanosis) and, eventually, shock.

Casualties with pneumothoraces deteriorate rapidly and will die in a matter of minutes if untreated. The treatment is decompression of the chest cavity. This is carried out by inserting a large-bore cannula into the side of the chest with the pneumothorax. The cannula should be inserted through the second intercostal space in the mid-clavicular line.

If available, oxygen should be administered and a chest drain inserted. Casualties with tension pneumothoraces require rapid evacuation.

5 A **haemothorax** is a collection of blood between the lung and the chest wall. Blunt or penetrating injuries cause bleeding from blood vessels in the chest wall or lung. It is often associated with a pneumothorax. A haemothorax is difficult to diagnose

without an X-ray but signs include decreased air entry and dullness to percussion over the haemothorax.

To manage a casualty with a haemothorax give oxygen, manage any associated shock, insert a chest drain (to drain the blood) and evacuate.

6 **“Sucking” chest wounds** are caused by holes in the chest wall from penetrating chest trauma. If the hole is sufficiently large, air passes into the chest cavity with inspiration through the hole rather than through the trachea. This rapidly results in respiratory failure. However, the wounds close off with expiration preventing air escaping. The result of this accumulation of air is a tension pneumothorax.

Sucking chest wounds should be covered with an occlusive dressing, which is taped down on three sides, with the fourth side left open. This type of dressing will close the wound during inspiration, stopping the flow of air into the chest.

Circulation

Trauma causes bleeding from wounds, blood vessels, internal organs and fractured bones. The body can compensate for a relatively large amount of blood loss in order to maintain the circulation to the vital organs. This compensation involves increasing the heart/pulse rate and the output of the heart, in addition to reducing blood flow to the skin and limbs.

Shock is the failure of perfusion of oxygenated blood to the body’s tissues. Shock due to blood loss or dehydration is hypovolaemic shock.

TABLE 14.4 SIGNS OF HYPOVOLAEMIC SHOCK

- Increased heart rate
- Increased respiratory rate
- Pallor
- Cold peripheries
- Delayed capillary refill time
- Reduced urine output
- Reduced conscious level if severe
- Reduced blood pressure if severe

All of the above signs of shock can have causes other than blood loss, such as cold peripheries and delayed capillary refill in a cold environment. The heart rate may be increased by pain or anxiety rather than shock. It should also be noted that young, fit individuals can lose over 30% of their circulating blood volume before their blood pressure falls.

TABLE 14.5 MANAGEMENT OF HYPOVOLAEMIC SHOCK

- Manage any airway and breathing problems, maintaining spinal immobilisation
- Provide oxygen if available
- Lay the casualty down
- Raise the legs
- Stop external bleeding with localised pressure and elevation
- Reduce and splint fractures
- Administer intravenous fluids

The source of bleeding should be located for the shocked casualties. The sites of massive bleeding include:

- Fractures of femur or pelvis
- Abdomen
- Chest – haemothorax
- External bleeding from wounds and open fractures.

Bleeding from wounds can almost invariably be stopped with firm direct pressure and elevation. Tourniquets no longer have a place in the control of haemorrhage from wounds. They should be considered only as a last resort for life-threatening haemorrhage from an amputated limb in a remote setting.

Bleeding can be considerable from *long bone fractures*, especially the femur. Applying manual traction, followed by a femoral traction device, greatly reduces pain and bleeding into the thigh. Traction to a fractured femur with overlapping bone ends reduces soft-tissue damage and elongates the thigh. This reduces the volume of the thigh and hence reduces bleeding. Femoral nerve blocks are very effective in providing pain relief for femoral shaft fractures.

Open fractures in the remote environment should be cleaned and reduced. This again will reduce blood loss. Following this they should be covered with an iodine dressing and splinted. Broad-spectrum antibiotics should be given for open fractures as soon as possible.

A number of studies have looked at the effects of intravenous fluid administration in trauma casualties in urban environments. These have suggested that intravenous fluids may adversely affect outcome if the casualty is relatively near a hospital.

Two explanations are suggested for this. The first is that inserting a cannula and administering fluids pre-hospital may delay the time to definitive care in hospital. Secondly, the fall in blood pressure with severe haemorrhage may cause flow through injured vessels to decrease. This decreased flow of blood at reduced pressure creates a better environment for coagulation to occur. Giving intravenous fluids, which have

no oxygen-carrying capacity, raises the blood pressure and hence the flow through the damaged vessels which may have “clotted off”. As a result, it is suggested that bleeding may restart, causing further blood loss.

However, profound shock in the seriously injured casualty results in damage to the brain and other vital organs due to lack of perfusion. This perfusion may be improved, at least in the short term, by administration of intravenous fluids.

No studies have looked at the use of intravenous fluids in shocked trauma casualties in remote expedition environments far from definitive care. Therefore it is difficult to say whether the results of the above studies are applicable to expedition medicine.

Disability

It is important to assess the conscious level and the pupils in injured casualties as part of the primary survey.

The conscious level may be reduced as a result of head injury. Frequently, however, casualties with no head injury may be unconscious because their airway, breathing or circulation is compromised, causing impaired brain perfusion.

The conscious level can be assessed using one of two scoring systems, AVPU or the Glasgow Coma Scale. These allow accurate information about the state of the casualty to be passed to others via the radio or telephone and allow the progress of the patient to be precisely monitored and recorded.

The simplest method is to use the AVPU scoring system, which assesses the patient’s response to verbal and then painful stimulus (see Chapters 12 and 13).

The most precise scoring system is the **Glasgow Coma Scale** (GCS) (see Figure 12.7, page 126). This scoring system is internationally recognised. The assessment is divided into three sections, examining eye movements, motor response and verbal response. A score is given for each of the sections and added together to give a score of between 3 and 15.

A score of 15 is normal and a score of 3 represents a casualty who is completely unresponsive. Coma is defined as a GCS score of less than 8.

Any casualty who is not “alert” on the AVPU scale or has a GCS score less than 15 following a head injury requires a formal medical assessment, usually necessitating evacuation.

The response of the pupils to light should also be examined following trauma. Normally the pupils are equal in size and reduce in diameter quickly when a light is shone into them. If, however, following a head injury the pupils are unequal or do not react quickly to light, this may indicate a serious head injury.

The ability to move all limbs spontaneously should also be checked and recorded following trauma.

Damage to the brain that occurs at the time of injury is called primary brain damage and, in the period following injury, secondary brain damage. Secondary brain

damage has a number of causes including lack of oxygen, shock and infection. The pre-hospital management of serious head injuries aims to reduce secondary brain damage. Assessment and management of the casualty's airway, breathing and circulation will maximise the perfusion of the brain. Spinal immobilisation and careful handling will avoid any spinal cord damage occurring after injury. Rapid evacuation is essential for serious head injuries.

FURTHER MANAGEMENT OF A SERIOUSLY INJURED CASUALTY

Following the primary survey the casualty should be examined from head to toe for injuries. This is known as the **secondary survey**. A note should be made of the casualty's pre-existing medical illnesses, drug history and any allergies he or she may have.

Casualties who are immobile will rapidly become hypothermic and should be provided with adequate shelter and insulation.

During transfer their airway, breathing, circulation and disability should be continually reassessed. Similarly, if the casualty deteriorates in any way, the cause should be located and the primary survey restarted with A, B and C.

MULTIPLE CASUALTIES

A road traffic accident or avalanche may result in a number of people on an expedition being injured simultaneously.

A multiple casualty incident should be managed with the aim of identifying those most seriously injured and treating them first before moving on to those with non-life-threatening conditions. This is known as triage.

Triage was introduced during the Napoleonic wars and is now used in all accident and emergency departments in the UK.

Casualties are split into three groups according to their need for treatment:

- Immediate – e.g. airway compromised or shocked
- Urgent – e.g. isolated open femoral fracture
- Delayed – e.g. wrist fracture.

A casualty carer should be given the role of triage officer. It is the job of this person to perform a rapid assessment of all casualties and place them into each of the three categories. The carer should not stay and treat any casualty during this triage process, known as the triage sieve.

Following the triage sieve, the casualties should be assessed and treated in order of urgency.

The leader of the expedition should stand back from the immediate care of casualties and plan further management of the incident. This includes group safety, shelter, communications and evacuation.

A useful mnemonic for highlighting the priorities for management of a multiple casualty incident is that used in the Major Incident Medical Management and Support course – “CSCATTT”.

- Command and Control
- Safety
- Communications
- Assessment of scene
- Triage
- Treatment
- Transport

SUMMARY

Much can be done in the remote environment for the seriously injured casualty with an effective primary survey. Seriously injured casualties require definitive surgical care at the earliest opportunity.

The primary survey is a dynamic process and should be continually evaluated during evacuation.

Incidents involving multiple casualties require triage and effective incident management.